

Description of some species and subspecies of the genus
Astarte from the Neogene of the Netherlands

by

G. SPAINK

Geological Survey of the Netherlands, Haarlem

Astarte alternicostata nov. spec.
figs. 6a-c

Astarte pygmaea Heering, 1950 (non Von Münster, 1837), p. 75, pl. 1 figs. 7, 8.

Shell small, softly shining, rather thick, rather convex, a little more broad than high. Ventral margin strongly and regularly curved. Dorsal margins nearly stretched, anterior side a little concave, posterior side a little convex. The anterior margin merges with a regular curve into the anterodorsal margin, the posterior side of the shell is weakly angular. Beaks prosogyrate, small, acute, not very convex. In well preserved shells a smooth, obliquely lanceolate prodissococonch is visible, its top lying at $2/3$ of its length, length 0.6 mm, height 0.5 mm. Shell surface of adult shells covered by ca. 35 rather strong ribs, which are separated by narrow, but deep furrows. On the uppermost part of the beak the ribs are fine, not flat and closely set. On the middle part of the shell surface, however, the ribs are broad and flat, but they become quickly narrower in both directions towards the dorsal margins. Where the ribs are broad and flat, they are not parallel to the ventral margin, but are more strongly curved and sagging. In adult shells, however, the ribs become narrower, more regular and parallel to the ventral margin. Thus, only in juvenile valves the ribs run out from both sides of the ventral margin. From the top to the posteroventral margin a very weak depression in the shell surface is present, only visible under incident light. In this depression the ribs alternate, often very regularly, and new ribs start just between two ribs coming from the centre of the shell, but the ribs may also alternate more irregularly over the whole breadth of the depression. In adult shells the ribs are stretched in the depression. This often causes one or two ribs to run out where the depression reaches the margin. In about 20% of my

specimens the ribs also alternate a little in the anterior part of the shell surface, but to a much slighter extent. The growth lines are everywhere visible on the shell surface. Where the ribs alternate, the growth-lines are visible as fine scratches on the ribs, or as fine bridges between the ribs. In well preserved shells mostly one or two concentric dark-coloured bands are present, often crossed by fine colour lines, radiating from the top. The colour pattern is better visible on a wet surface, especially the radiating lines.

Lunula and escutcheon narrow, smooth, weakly concave, long and lanceolate.

Interior of the shell pale and glossy. Adductor scars and pallial line clear. Shell margin smooth or crenulated by ca. 35 crenulations. Hingeplate rather narrow, the nymph (ligament groove) small and shallow, lying very high on the hinge plate. Hinge typical for the genus. Lateral teeth distinct, reaching the crenulation of the margins.

Measurements of holotype: length 5.5 mm, height 5.1 mm, thickness 1.5 mm.

Geological range: Upper Miocene, possibly Pliocene.

Type material. Holotype and 9 paratypes: Reek, "Flachbohrung 41", 45F/48, depth 14.00 – 31.80 m. Pliocene, but the specimens are possibly derived from the Upper Miocene, whose top lies at 32.00 m. depth. About 1000 paratypes: Bakel, "Flachbohrung 47", 52A/9, depth 66.00 – 88.00 m; Upper Miocene. About 300 paratypes: Beers, "Flachbohrung 53", 46A/10, depth 75.00 – 90.00 m; Upper Miocene.

Juvenile specimens of *Astarte alternicostata* resemble the Pliocene *A. excurrens* Wood, 1853, as Glibert (1957: 8) had already noticed. *A. alternicostata* is presumably the ancestor of *A. excurrens*. There are, however, many typical differences between these two species. *A. excurrens* reaches a length of 4.1 mm, whereas *A. alternicostata* reaches 6.5 mm. In *A. excurrens* the ribs are never alternating anywhere on the shell surface. *A. alternicostata* is heavier built and more triangular in outline, especially above the horizontal midline, whereas *A. excurrens* is oval and broader. Also, in adult shells of the latter the ribs run out on both sides. There are also differences in the ribs of juvenile valves of the same size. In *A. excurrens* the ribs on the umbo are broader and stronger and sag more than in *A. alternicostata*, where the oldest ribs hardly do so. At least where the ribs are broadest, they are flat in *A. alternicostata*, but with a slightly rounded top in *A. excurrens*.

Astarte irregularis nov. spec.
figs. 4, 7a-c, 8a-b

Shell thin, flat, broadly oval in outline, shining. Beaks acute, placed in the middle, a little prosogyrate. Whole outer surface covered by fine irregular concentric ribs, which are separated by narrow grooves, about half as broad as the ribs. These ribs are regular to rather regular on the umbo, but they soon become very irregular, at first in the posterior and anterior parts, but soon also in the middle of the shells. The irregularity is demonstrated by irregular alternation (mostly in the posterior and anterior parts, but later also in the central part), insertion of ribs halfway the other ones (mostly in the middle lower part of the surface), zigzagging (mostly in the posteroventral region), getting broader and narrower and even vanishing or fading away (mostly in the posterior part) and appearing and again disappearing of ribs (mostly in the middle of the ventral region). These are not necessarily met with in one and the same shell. In shells with disappearing ribs the latter are mostly low and broad on the umbo and very soon become irregular. Close to the posterodorsal margin a weak, but clear depression runs from the top to the posteroventral margin. In this depression the ribs are stretched if they are not too irregular. Lines of growth are hardly visible. Three paratypes each show two faint concentric colour bands.

Interior less shining than exterior surface. Muscle scars distinct and a little impressed, pallial line not always so. Hinge plate very narrow, also in the central part. Cardinal teeth very small. Ligament groove very narrow. Lunula distinct and rather deep, narrow and long. Escutcheon very narrow, shallow, nearly as long as the lunula to twice as long. Inner margin smooth or crenulated by distinct, long crenulations.

Measurements of holotype: length 15.0 mm, height 13.4 mm, thickness 3.0 mm. All Dutch paratypes are smaller, all paratypes from the crags of East Anglia are larger, up to 20.0 mm.

Geological range: Upper Pliocene.

Type material. Holotype: Westerschelde near Ellewoutsdijk, dredged from Pliocene deposits from a depth of about 22 – 28 m for harvesting shells for lime kilns. Found in the shell heaps of the lime kiln of Brielle.

Paratypes: Clinge (St. Jansteen), boring 55A/46, from 7.00 – 9.50 m depth; one specimen. Borings at Flushing, depth unknown, 2 specimens. Domburg, washed ashore, 1 specimen. Beaumont, Essex, Waltonian Crag, British Museum (Natural History), Palaeont. Depart-

ment No. L.32539, F.W. Harmer coll., 1 specimen. East Anglia, Waltonian Red Crag, locality unknown, 6 valves, all measuring between 20.0 and 15.0 mm.

I have seen a number of very well preserved specimens in the collection of Mr. A. Wieles at Terneuzen, found in the local subsoil. Unfortunately this collection has only become available recently so that the shells have not as yet been investigated thoroughly.

This species is closely related to *Astarte incerta*, Wood 1853, which may be the ancestor of *A. irregularis*. I have described *A. irregularis* as a separate species because of the following differences with *A. incerta*. *A. irregularis* is flatter, especially in the umbonal region. In juvenile shells of *A. incerta* the cardinal teeth are one and a half times to twice as long as in shells of *A. irregularis* of the same size; this is most marked in the triangular tooth in the right valve. The lateral teeth are narrower. Muscle scars are larger and are situated lower down, the pallial line lies also lower, i.e. closer to the ventral margin than in juvenile shells of *A. incerta* of the same size.

The sculpture is very different. In *A. incerta* the ribs are acute, very narrow, crowded and very regular, although some irregularity is visible on a small scale, mostly in the posterior depression. Both species show concentric colour bands. In *A. incerta* these bands are distinct and persistent and are found in the concentric depression in the shell surface, which shows a weak, but mostly distinct undulation. In *A. irregularis* there is no concentric depression, the colour pattern being weak and often absent.

In Dutch specimens I have not seen any intermediates between *A. incerta* and *A. irregularis*. Among material from the crags of East Anglia, however, I have seen material, which is partly intermediate between the two species. At first I supposed that the irregularity of the sculpture was due to damage to the animal's mantle margin. This may be true in some cases, but in most shells no defect or damage of older shell margins could be observed. As such an intermediate form I consider a specimen from the Waltonian Red Crag, Beaumont, Essex, coll. F.W. Harmer, No. L.32540 and some specimens from Little Oakley, Waltonian Red Crag, coll. F.W. Harmer, No. L.31943-5, all preserved in the Palaeontological Department of the British Museum (Natural History) This material had been identified as *A. crebricostata* Forbes.

Astarte omalii latecostata nom. nov.
figs. 1a-b

"*Astarte omalii* Delajonkaire var. *undulata*" Wood, 1853, non Say, 1824, Wood, 1853, p. 180, pl. 17, fig. 1c.

Shell thin, flat, triangular in outline. Beaks acute, prosogyrate, placed in front of the centre, outer surface covered by concentric ribs. These ribs start as fine ribs on the beak, but very quickly they become regularly stronger and stronger resulting in heavy, robust, wave-like ribs, which run parallel to the weakly curved margin. The spaces between the ribs are just as broad as the ribs are or even broader. Between the ribs the shell is very thin and transparent. The inner surface is weakly undulated corresponding to the strong ribs. The stronger the inner surface undulates, the more transparent is the shell between the ribs. Hinge typical for the genus, but strongly curved in the cardinal region. Lateral teeth straight, long. Lunula and escutcheon distinct, small and deep. Muscle scars normal. Inner margin sometimes crenulated. Measurements of shell (figs. 1a-b): length 20.3 mm, height 20.3 mm, thickness 4.5 mm.

Geological range: Upper Pliocene.

Material examined: Westerschelde, near Ellewoutsdijk, found in the shell heaps of the lime kiln at Brielle, 4 specimens. Koudekerke, boring K.37, 48A/46, depth 38.00 – 40.00 m; Uppermost Upper Pliocene, 1 specimen. Domburg-Westkapelle, washed ashore, 2 specimens. Ritthem near Flushing, washed ashore, 1 specimen. Orford, East Anglia, Coralline Crag, 3 specimens. Sudbourn Hall, Coralline Crag, 1 specimen.

This subspecies is connected with the parent species *Astarte omalii omalii* de la Jonkaire via *A. omalii bipartita* Sowerby (fig. 3).

A. omalii bipartita has a strongly ribbed and flat umbo, as if the umbonal region had been depressed. Both sides of the flat part are sharp-edged and a little convex, especially the posterior edge. From this results a sharp, pointed beak, which is very typical of the *A. bipartita-latecostata* group. This flat and strongly ribbed part is sharply separated from the rest of the outer shell surface, which is convex and smooth. The flat part occupies not only the uppermost part of the shell surface, but may also occupy half the entire surface or more. The more the surface is occupied by this flat part, the more the form changes into that of the subspecies *latecostata*.

Wood's name *undulata* was already used by Say in 1824 for an American Miocene species. *A. undulata* Say is oval in outline, with an angulate posterior margin and a broadly rounded anterior margin

and with narrow ribs, which do not reach the ventral margin.

I consider *A. omalii latecostata* a separate subspecies, for it is the product of a separate range in the development of *A. omalii* towards the end of the Pliocene, when all Pliocene *Astarte* species had become extinct (see Spink, 1972, in the press). *A. omalii latecostata* is morphologically independent; nothing resembles or is even reminiscent of *A. omalii omalii*, from which it presumably has descended.

The variety or rather subspecies *A. omalii acuminata* Wood, 1853, pl. 17 fig. 1e, is the product of another range of variation. In this range the beak is prominent and rather strongly ribbed. The ribbed part is not flat or sharply separated, however; the outer shell surface is regularly and weakly curved from the beak to the ventral margin. This variety, figured by Heering, 1950, on pl. 4 fig. 1, shows convergence with the *A. bipartita-latecostata* group.

Astarte mutabilis altenai nov. subspec.
figs. 5a-c, 9a-c

Astarte (Isocrassina) mutabilis Wood, 1840, sensu Glibert, 1957, p. 4, pl. 2 fig. 3 (juvenile valve).

Adult shell very large (to my knowledge the largest *Astarte* species). Broadly oval in outline, rather convex. Ventral margin weakly curved, posterior margin long, weakly curved to nearly stretched, anterior margin regularly and strongly curved. All margins fade into each other, especially the ventral into the anterior margin. Beaks prosogyrate, directed inwards. Umbo not strongly protruding as in *Astarte mutabilis*, carrying a set of regular concentric fine ribs. Outer surface smooth, regularly convex over the whole surface. No "shoulder" (a rounded ridge, running from the beak to the posteroventral margin) is present as in *A. m. mutabilis*. A weak depression is present in the posterior part of the umbo, but this depression fades away soon and does not reach the margin, but some weak, small lines, lying in this depression or bordering it, still reach the posteroventral margin (visible under incident light). The muscle scars are large; the pallial line is distinct and short, and lies far from the margin. From the lumen under the hinge plate to the posterior half of the pallial line a depression is present on the inner surface the shell. This depression is characteristic for *A. mutabilis*, and is absent in all other Pliocene *Astarte* species. In juvenile valves it is

sometimes absent, but in adult shells it is always present. Hinge plate broad and short, occupied by strong cardinal teeth and by the very large, broad and long nymphal plate of the ligament. This nymphal plate occupies 3/4 of the posterior part of the hinge plate and reaches the lower edge of it. Lateral teeth poorly developed. Inner margin crenulated, simple or with a rim of up to 2 mm wide. The inner edge of this rim is never stretched or concave as in *A. m. mutabilis*, where this rim may reach a thickness of 4 to 5 mm in the middle part.

Measurements and type material. Holotype: Westerschelde near Ellewoutsdijk, found in the heaps of Pliocene shells of the lime kiln at Brielle. Length 47.5 mm, height 40.0 mm, thickness 10.0 mm. Paratypes: adult shell, same locality, length 50.2 mm, height 40.0 mm, thickness 11.8 mm. Juvenile valve, boring K43, 54F/10, Catharinahof, Catharinapolder near Axel, Zeeuwsch-Vlaanderen, depth 11.50 – 13.20 m. Upper Pliocene; see figs. 5a-c.

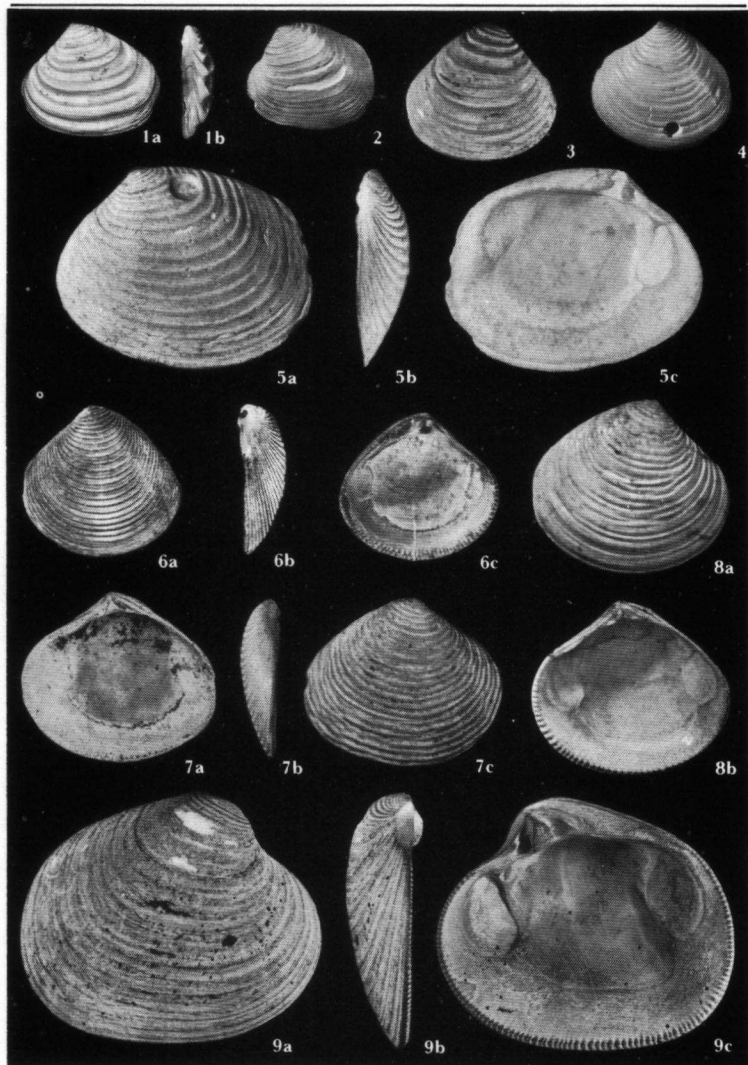
Geological range: Upper Pliocene.

I dedicate this subspecies to Dr. C.O. van Regteren Altena, curator of Mollusca, Rijksmuseum van Natuurlijke Historie, Leiden.

Although I have only three specimens at hand I have seen more material of this subspecies in several private collections.

This subspecies is easily distinguished from *Astarte m. mutabilis* by its rounded outline and its low beak, which is not very convex and not protruding. *A. m. mutabilis* is squarish in outline and has a heavy, broad, very convex, and strongly protruding umbo, which lies more towards the posterior end. Juvenile shells are very different indeed. Juvenile valves of *A. m. mutabilis* are very convex, have a "shoulder" and are already squarish in outline. Measurements of the specimen, illustrated in fig. 2: length 15.8 mm, height 12.0 mm, thickness 4.1 mm. Compare these dimensions with those given for the juvenile paratype. The juvenile valve of *A. mutabilis altenai* is broad, oval, flat (also in the umbonal region), and regularly convex over the whole surface. Glibert (1957, pl. 2 fig. 3) gives a figure of a juvenile valve, which in all respects agrees perfectly with the juvenile paratype figured in the present paper.

All holotypes and most of the paratypes are in the collection of the department of macropalaeontology of the Geological Survey, Haarlem. Other paratypes have been distributed as follows: 1 = Rijksmuseum van Natuurlijke Historie, Leiden; 2 = Zoölogisch Museum, Amsterdam; 3 = Rijksmuseum van Geologie en Mineralogie, Leiden; 4 = Institut Royal des Sciences Naturelles de Belgique,



Figs. 1-9. Neogene *Astarte* from the Netherlands. 1a-b, *A. omalii latecostata* nom. nov. 2, *A. m. mutabilis* Wood, juvenile. 3, *A. omalii bipartita* Sowerby. 4, *A. irregularis* nov. spec., paratype. 5a-c, *A. mutabilis altenai* nov. subspec., juvenile paratype. 6a-c, *A. alternicostata* nov. spec., holotype. 7a-c, *A. irregularis* nov. spec., holotype. 8a-b, Do., paratype. 9a-c, *A. mutabilis altenai* nov. subspec., holotype. Figs. 1, 2, 3 and 9 ca. 5/6x; figs. 4, 5, 7 and 8 ca. 5/3x; fig. 6 ca. 4x.